

What is Claimed:

- 1 1. An ultrafast nonlinear all-optical switch having a switching
2 speed of less than 1 picosecond for light with a wavelength of about 1.55
3 micrometers, the switch comprising:
 - 4 (a) a substrate; and
 - 5 (b) a material disposed on the substrate, the material including a
6 plurality of carbon nanotubes and a polymer forming a composite.
- 1 2. The material according to claim 1 wherein the material is a
2 third-order nonlinear optical material.
- 1 3. The material according to claim 1 wherein the material is
2 substantially transparent.
- 1 4. The material according to claim 1 wherein the polymer is
2 polyimide.
- 1 5. The material according to claim 1 wherein the nanotube
2 loading is less than about 0.1 wt %.
- 1 6. A nonlinear optical material comprising a plurality of
2 carbon nanotubes and a polymer forming a composite.
- 1 7. The material according to claim 6 wherein the material is a
2 third-order nonlinear optical material.
- 1 8. The material according to claim 6 wherein the material is
2 substantially transparent.
- 1 9. The material according to claim 6 wherein the polymer is
2 polyimide.

1 10. A nonlinear optical article comprising:

2 (a) a substrate; and

3 (b) the material of claim 6 disposed on the substrate.

1 11. The nonlinear optical article according to claim 10 wherein
2 the article is an ultrafast all-optical switch.

1 12. The ultrafast all-optical switch according to claim 11
2 wherein the switch has a switching speed of less than 1 picosecond for light with
3 a wavelength of about 1.55 micrometers.

1 13. A process for preparing a nonlinear optical switch
2 comprising:

3 (a) preparing a plurality of carbon nanotubes;

4 (b) suspending the nanotubes in a solvent;

5 (c) sonicating the nanotube-and-solvent suspension, yielding a
6 suspension with substantially uniformly distributed nanotubes;

7 (d) separately dissolving a polymer resin in the solvent, yielding
8 a polymer solution;

9 (e) mixing the nanotube-and-solvent suspension and the polymer
10 solution, yielding a uniform distribution of nanotubes in polymer solution;

11 (f) baking the nanotube-polymer solution to remove most of the
12 solvent;

13 (g) curing the polymer resin;

14 (h) baking the nanotube-polymer composite to remove any
15 retained solvent and to form a nonlinear optical nanotube-polymer composite
16 material; and

17 (i) depositing the material on a substrate.

1 14. The process according to claim 13 wherein the step of
2 depositing the material on the substrate is accomplished using lithography
3 techniques.

1 15. The process according to claim 13 wherein the carbon
2 nanotubes are purified before they are suspended in the solvent.

1 16. The process according to claim 13 wherein the concentration
2 of the carbon nanotubes is tuned to achieve predetermined properties in the
3 material.

1 17. The process according to claim 13 wherein the polymer is
2 polyimide.

1 18. The process according to claim 13 wherein the step of
2 preparing the nanotubes includes applying the HiPCO method.

1 19. The process according to claim 13 wherein the solvent is γ -
2 butyrolactone.

2 (a) a substrate; and

3 (b) a material disposed on the substrate, the material including a
4 plurality of carbon nanotubes incorporated into a silica.